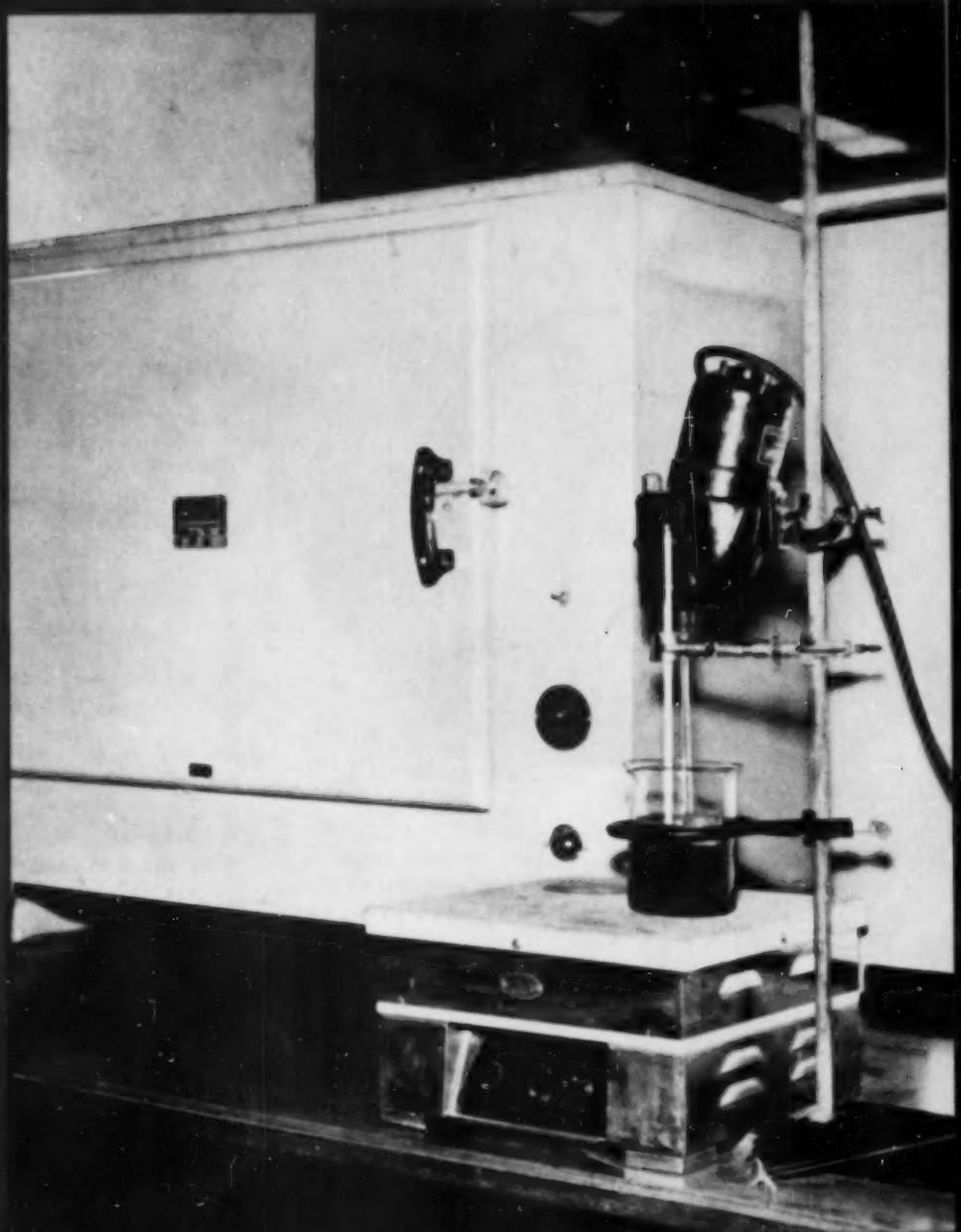
The Spokesman

OCTOBER 1950



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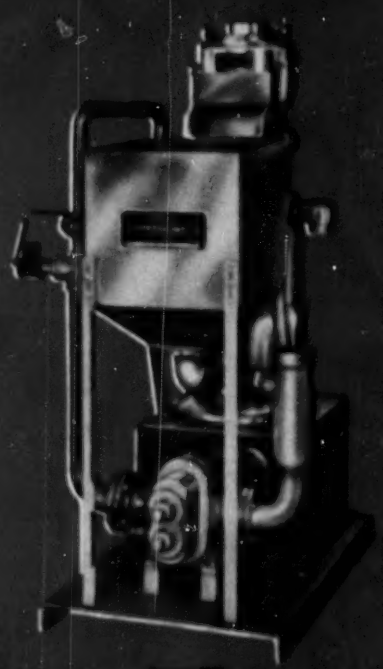

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ABOUT THE COVER

This illustration shows laboratory grease-making apparatus typical of that recommended in the article "Grease-Making in Miniature" which will appear in a later issue of THE SPOKESMAN. The friction-drive motor effectively agitates greases up to No. 3 consistency with the propeller stirrer shown. A 600-ml. beaker provides sufficient capacity for making 300-400 gram batches and is held in place by a standard laboratory ring support with a split cork to prevent rotation.

The hot-plate is rheostat controlled to allow the heating rate to be varied at will. A plate of this size will heat for grease samples simultaneously.

The electrically-heated cooling oven is large enough to accommodate ten to fifteen samples, and may be adjusted to any temperature up to 350° F. by means of its thermostat. Air vents in the bottom and a variable damper at the top (not shown) provide close control of the rate at which the oven and contents return to room temperature. This type of oven is also well-adapted to automatic control of cooling conditions by robot instruments.

LUBRICATE FOR SAFETY - EVERY 1,000 MILES -

President's page

by Arthur J. Daniel, President, N.L.G.I.

Mobilization *and the* NLGI

According to the small dictionary in my office, the word "mobilization" means "the act of assembling, equipping, and preparing military and naval forces for active hostilities". All of us realize that this is an inadequate definition that tells only a small part of the story.

I have been told that there are five basic "power factors" which determine the strength of a nation: (1) man power, (2) natural resources, (3) productive capacity, (4) economic structure, and (5) technological superiority. In a state of warfare, hot or cold, the nation which possesses superiority in these "power factors" will have the advantage over its opponent.

Let us consider, for the moment, each of these basic "power factors". Ours is a nation with a vast reserve of "skilled" man power—the natural resources we possess are among the finest in the world in quantity and quality—our productive capacity is second to none—our economic structure is the soundest in the world today—and last, but not least, our stage of technological development is undeniably superior to that of any potential enemy.

Lacking in one of these basic "power factors", a nation must attempt to overcome this disadvantage by increasing its strength in other "power factors". It is apparent that the weakest spot which might develop in our national defense is the numerical superiority in "unskilled" man power which an enemy might muster. Therefore, what we lack in "unskilled" man power, we must overcome by increasing our superiority in technical developments.

The average man understands technological superiority when you speak in terms of military weapons such as the proximity fuse, the bazooka, and the atomic bomb. But, he does not always understand that the superior technical advancements within industry are just as vital as superior weapons.

The events of the past few months have made it clear that the NLGI is now, more than ever before, an important cog in our nation's defense. Mobilization of physical assets is not enough to preserve our nation's freedom. The mobilization of technical knowledge and research is equally essential and can best be accomplished through technical associations such as the NLGI.

National mobilization has placed a challenge before the NLGI. Operating under an accelerated national defense program, the Lubricating Grease Industry will be called upon to produce new and better lubricants with urgent speed. And, the NLGI, as the industry's leader, must accept the responsibility of helping our nation maintain its advantage of technological superiority.

by HARRY D. MARTIN,

Assistant to Manager of Research and Development,
New Departure Division of General Motors Corporation,
Bristol, Connecticut

For Integrally
Sealed and Shielded
Ball Bearings

Lubrication Life Forecast AND Test Procedure

Since New Departure first developed the completely self-enclosed ball bearing, with contact seals on both sides, a major problem has been to develop a grease which would have a useful life in excess of the normal fatigue life of the bearing under the greatest possible variety of operating conditions.

At present the life of an integrally sealed or shielded bearing, depending solely on its original grease for lubrication, is, for lightly loaded bearings, the oxidation life of the grease, which in turn is dependent upon the temperatures of the grease at work on the ball, ball race and separator surfaces. These internal temperatures are not accessible but are related to the exterior temperature of the bearing rings, and, for convenience, the bearing stationary ring temperature may be called bearing operating temperature.

The degree to which a given bearing operating temperature affects grease life depends on the source of heat from which it develops.

The principal factors affecting operating grease temperature are:

1. Heat gain from parts or mechanisms adjacent to the bearings such as electric motor windings, gears, furnaces, clutches, engines, seal friction or from hot atmosphere, windage, etc.
2. Heat due to grease internal friction, which is affected by bearing race speed and ball and separator velocity.
3. Heat due to rolling friction, which is affected by load, speed and bearing internal design.
4. Heat loss by conduction, radiation and convection as affected by bearing size and surrounding housing and shaft material.

It has been found that a given rise in bearing operating temperature, as measured on the stationary bearing ring, affects grease life least if it is caused by heat developed outside the bearing, and most when caused by heat from bearing friction, particularly that due to load.

ACCELERATED TESTS NOT CONCLUSIVE

Acceleration of grease testing by high ambient temperatures, high speeds or heavy overloading can produce very misleading results as to how the grease will perform under actual service conditions, and it is recommended that where a grease is going to be used under certain specific conditions, that tests be conducted under these conditions whenever possible.

Integrally sealed, grease lubricated ball bearings are, however, operated under the most varied service conditions and it is essential for maximum value and reliability of results, that New Departure tests be conducted from sub-zero to +250° F. ambient temperatures, under low and high speeds and from negligible to heavy loading.

For easier correlation, all New Departure tests are conducted with bearings 88503 and 88507, which are sealed on both sides and bearings 77503 and 77507, which have shields on both sides. Bearing design, grease volume, and mounting practice are standardized so as to segregate grease as the only variable in so far as possible. All temperatures are measured on the outer ring, as close as practical to the point of maximum ball load, the inner ring being the revolving member.

77000
Shielded
88000
Sealed

SORTING PROCESS IN TESTING

It is manifestly impossible to fully test all of the excellent greases on the market. Many greases, though acceptable ball bearing lubricants, would not be suitable for self-enclosed or sealed bearings due to difficulty in retain-

CHART 1

GREASE TEST RECORD

Lubricant Trade Name _____

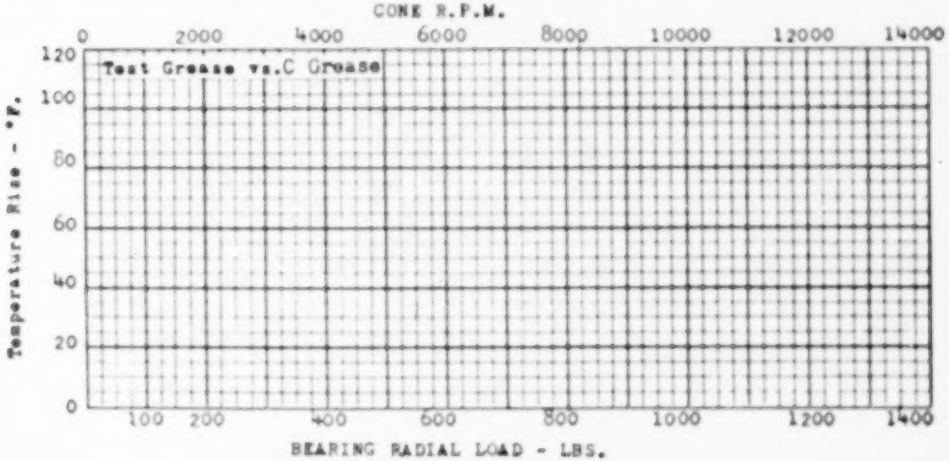
Vendor's Name and Address _____

CHEMICAL AND PHYSICAL PROPERTIES - Vendor ☐ N.D. ☐			
Meets Gov't. Spec. No.		A.S.T.M. Penetration	Unworked
Soap - Type and %			Worked 60 Strokes
Oil - Type Vis., Additives			Worked 100,000 Strokes
Bleeding		Structure, Color, etc.	
Evaporation		Oxidation Bomb Test	
Dropping Point		Water Resistance	
Copper Strip Corrosion		Dirt Count	
		Torque	

NEW DEPARTURE TEST DATA								
Brg. Make, Size, Spec.					Air Space Vol. of Brg. in cc = V =			
			Test Lub.	C Gr'se			Test Lub.	C Grease
Specific Gravity					Radial Load-lbs.			
A = Amount of Lub. in Brg.	% of V				Thrust Load-lbs.			
	Grams				R.P.M.			
Ave. Operating Temp. °F.					Load Factor			
Ambient Room Temp. °F.					Expected Life			
Ave. Grease Leakage	100 Hrs.	Grams			Ave. Test Life-hrs.			
		% of A			Grease Failure	No. of Brgs.		
	Final	Grams				Ave. Life		
		% of A			Other Failures	No. of Brgs.		
						Ave. Life		

REMARKS: _____

Temp. Rise of 88503 and 88507 Brgs.
(1) At 3000 R.P.M. under Various Loads (2) Under Zero Load at Various R.P.M.



ing them under all conditions. For such reasons a sorting process is necessary, as follows:

1. Six 88503 and two 77503, or six 88507 and two 77507 bearings are lubricated with the subject grease. The quantity inserted in each bearing is equal to 25 per cent of the air space volume inside the bearing, i.e. between the seals or shields. Use of this amount precludes any appreciable leakage which might affect the results.

2. Two 88000 series bearings are run under no-load at from 1000 to 10,000 inner ring r.p.m. to obtain the self-induced temperature vs. inner ring r.p.m.

3. Two 88000 series bearings are run at 3000 r.p.m. with radial load varying from no-load to twice the rated capacity at this speed to obtain the self-induced temperature vs. radial load.

4. Two 77000 series bearings are run under 25 lbs. radial load at 30, 1000 and 3000 inner ring r.p.m. and the grease torque measured. Shielded bearings are used to eliminate the friction factor of contact seals.

5. Two 88000 series bearings are run at 3000 inner ring r.p.m. at no-load to determine grease leakage past seals.

6. Chemical analysis and oxidation tests are carried out to determine if subject grease meets vendor's advertised specifications.

The results obtained as outlined are entered on the special grease test form, Chart No. 1, which gives sufficient information to determine whether or not the grease tested warrants further consideration for New Departure sealed or shielded bearings. If so, a minimum of ten bearings are properly grease lubricated and are run at 3000 inner ring r.p.m. under 1.8 times the rated radial capacity at this speed and at self-induced temperature.

A like number of similar bearings are run until failure at 3000 inner ring r.p.m. no-load and ambient temperature of 250°F. as measured on bearing outer, or stationary ring.

OPERATION OF NEW DEPARTURE TESTING MACHINE

There are many designs of grease testing apparatus which are used to duplicate specific installations, but for overall grease testing with sealed or shielded bearings, the machine illustrated in figure 1 has given the best results.

This machine allows the testing of 0 to 7 bore[1] (10 to 35 mm) bearings under any kind or combination of loads at speeds of from 360 to 10,000 r.p.m. at room or controlled ambient temperatures up to 300°F.

Machines of this type are composed of twelve to sixteen

In the following table the range of bore sizes from 0 to 22 are given with the corresponding metric dimensions and their inch equivalents.

BEARING BORE SIZES
in inches and millimeters

BORE NUMBER	BORE DIAMETER MILLIMETERS	BORE DIAMETER IN INCHES
0	10	.3937
1	12	.4724
2	15	.5906
3	17	.6693
4	20	.7874
5	25	.9843
6	30	1.1811
7	35	1.3780
8	40	1.5748
9	45	1.7717
10	50	1.9685
11	55	2.1654
12	60	2.3622
13	65	2.5591
14	70	2.7559
15	75	2.9528
16	80	3.1496
17	85	3.3465
18	90	3.5433
19	95	3.7402
20	100	3.9370
21	105	4.1339
22	110	4.3307

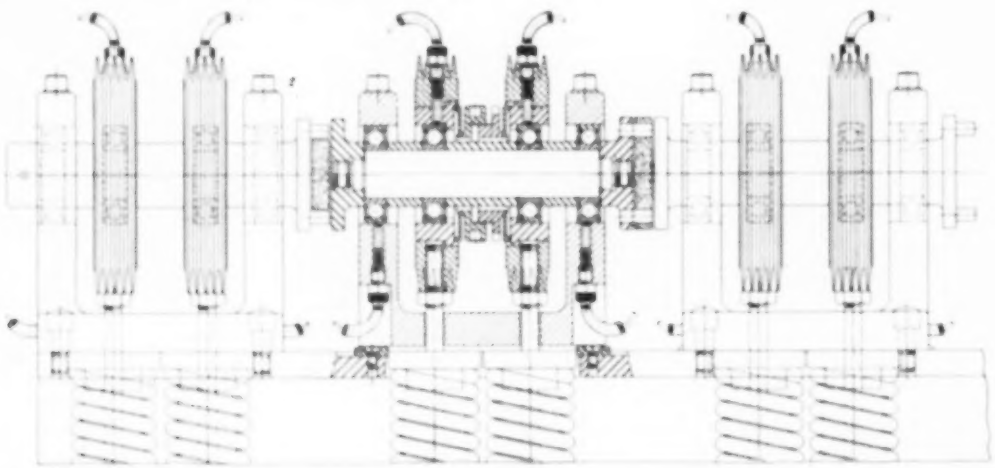


Fig. 1

stations, each station accommodating four test bearings. The bearings in each station are clamped on a common arbor using A.B.E.C.-1 fits.

The two center bearings are individually spring-loaded radially and the end bearings carry the reaction. The center bearings may also be thrust-loaded by means of Belleville spring washers with a stud and nut device as shown in section. The end bearings can be run under radial load only.

As shown in figure 1, the center bearings being individually housed and loaded eliminate transfer of heat which might occur were both in a single housing. Temperatures of the four bearings are brought very close to a common level by cutting radiating fins in the center bearing housings and insulating the end bearings, thereby equalizing the effects of radiation and convection.

Center bearing housings are of aluminum with steel liners to obtain maximum heat conduction. Housings of end bearings are made of high carbon chrome AMS-5365 cast steel, chosen for low heat conduction properties.

Thermocouple wires properly fixed to each test bearing outer ring, connect with a recorder which registers the operating temperatures of the individual bearings every half hour.

The recorder is preset to slightly higher than the normal bearing temperature and functions to stop the machine if abnormal temperatures occur, and records which bearing is running hot and the time at which the machine was stopped.

In addition, an operator listens with an engineer's stethoscope to each bearing at four hour periods to detect any occurrence of fatigue that might not cause sufficient temperature rise to stop the machine, but might affect grease life.

LIFE FORECAST OF NEW DEPARTURE SELF-ENCLOSED BEARINGS, LUBRICATED WITH NEW DEPARTURE "C" GREASE

Study and analysis of many years laboratory and field data have resulted in the following:

1. A method of forecasting average life of any series and size of grease lubricated, sealed or shielded ball bearing, under *negligible load* with the inner ring revolving and the speed and outer ring temperature previously determined.

2. A method of forecasting average life of single row, non-filling slot, grease lubricated, sealed or shielded bearings under *any load*, with the inner ring revolving and the bearing size, speed, load and outer ring temperature previously determined.

These forecasting methods being largely empirical are not regarded as perfect and are subject to modifications which may be dictated by future experience. However, they systematically consider the effects of temperature, speed, load and bearing size and, used in conjunction with field experience, can be useful tools in the application of grease lubricated bearings.

There may be many instances where the bearing user will conservatively anticipate greater sustained bearing loads, temperatures and operating periods than will actually occur in a new or established machine.

A forecast based on these anticipated conditions could give poor life values, whereas, under actual operation a grease lubricated bearing would give very satisfactory performance. It is highly important therefore that theoretical considerations be tempered with a reasonable estimate of average operating conditions.

FORECASTING FOR BEARINGS UNDER NEGLIGIBLE LOAD

To decide whether applied load may be disregarded, determine value of load factor, f, under which bearing will operate, i.e., f = capacity/radial load.

Enter Table 1 with this factor and the r.p.m. at which bearing will run. If it is equal to or larger than that in Table 1, solve for greased bearing life in which

Forecasted Average Life = $B_G \times S_G$

B_G is the Basic Life—to obtain it, enter Chart II with the known outer ring temperature and find B_G on the vertical scale.

TABLE 1

Load Factors f at various r.p.m. under which bearings will give at least 90% of zero-load life.

Bearing	r. p. m.						
Bore No.	500	1000	2000	4000	10000	20000	40000
N.D. 34- 1	4	5	7	9	13	18	25
2- 5	3.5	4.5	6	7.5	11	16	
6-10	3	3.5	5	6.5	10		
11-15	2.5	3	4	5.5	8		
16-20	2	3	4	5	7		

S_G is the Speed Factor—to obtain it, enter Chart III with the known outer ring temperature and inner ring r.p.m. and find S_G on the vertical scale.

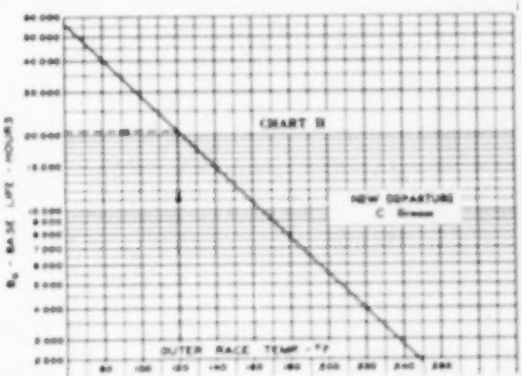
If load factor f, of bearing under study, is smaller than that in Table 1, use the forecasting method given below which considers load, provided bearing is single row, non-filling slot type. For other types see later comments under Single Row Angular Contact, Double Row, etc.

Example:

A 77506 bearing supporting shaft of electric motor operates at 1800 r.p.m. under 100 lb. radial load. Outer ring temperature 108° F. what is forecasted average life?

Solution:

a. Capacity of 77506 brg. at 1800 r.p.m. = 879 lbs.
Load factor f = 879/100 = 8.79 (Ref. N.D. Handbook, Vol. I)



b. Load factor of 8.79 is larger than that in Table I for a 6 bore bearing at 1800 r.p.m., hence the effect of load can be disregarded.

c. Forecasted average life =
$B_G \times S_G = 25000 \times 1.05 = 26{,}200$ hours.

B_G = 25000 from Chart II S_G = 1.05 from Chart III

FORECASTING METHOD FOR SINGLE ROW, NON-FILLING SLOT BEARINGS RUNNING UNDER LOAD

Forecasted average life = $B_G \times S_G \times L_{SG}$

The factor B_G and S_G are taken from Charts II and III as explained previously.

L_{SG} is the load-speed factor. To obtain it, three steps are required.

1. Solve for the ratio T/R (Thrust Component divided by Radial Component). Find in Table 2 Conversion Factor A corresponding to this ratio. Multiply radial component by Conversion Factor A to obtain effective radial force. For pure thrust and values of T/R greater than 8, multiply the thrust component by 2.1.

2. Enter Chart IV or V with effective radial force and bearing r.p.m. and find intermediate factor I on vertical scale.

3. Enter Table 5 with intermediate factor I and bearing size and find load-speed factor L_{SG} in first column.

Example:

A 99505 bearing in a gear box operates at 3600 r.p.m. under 120 lbs. radial and 60 lbs. thrust load, outer race stationary with temperature 120°F. What is average life to be expected as determined by grease breakdown?

Solution:

a. From Chart II, base life B_G = 20,800 hours.

b. From Chart III, speed factor S_G = .97

c. T/R* = 60/120 = .5. Conversion factor A from Table 2 = 2.35*.

Effective radial force = 120 X 2.35 = 282 lbs. Intermediate factor I, from Chart IV = 540. Load-Speed factor from Table 5 = .52

Forecasted average life = 20,800 X .97 X .52 = 10,490 hours.

TEST VS. FORECAST LIFE

In Table 3, greased bearing life obtained under known laboratory conditions is compared against life estimated by the forecast method.

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*T = Thrust Load
R = Radial Load

*For complete description of New Departure bearing numbering system, see footnote 3 on page 18.

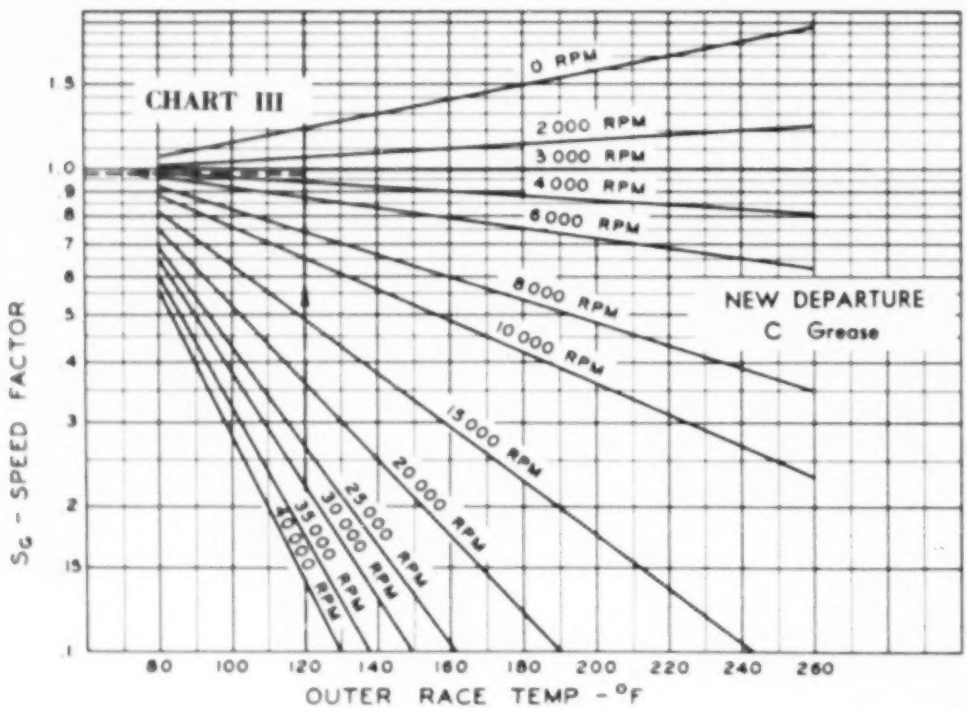


TABLE 2

Thrust Load / Radical Load	0	.05	.10	.2	.4	.6	.8	1.0	2.0	4.0	6.0	8.0	Pure Thrust
Conversion Factor A	1.0	1.13	1.30	1.62	2.1	2.6	3.0	3.3	5.2	8.8	12.7	16.8	2.1

CHART IV

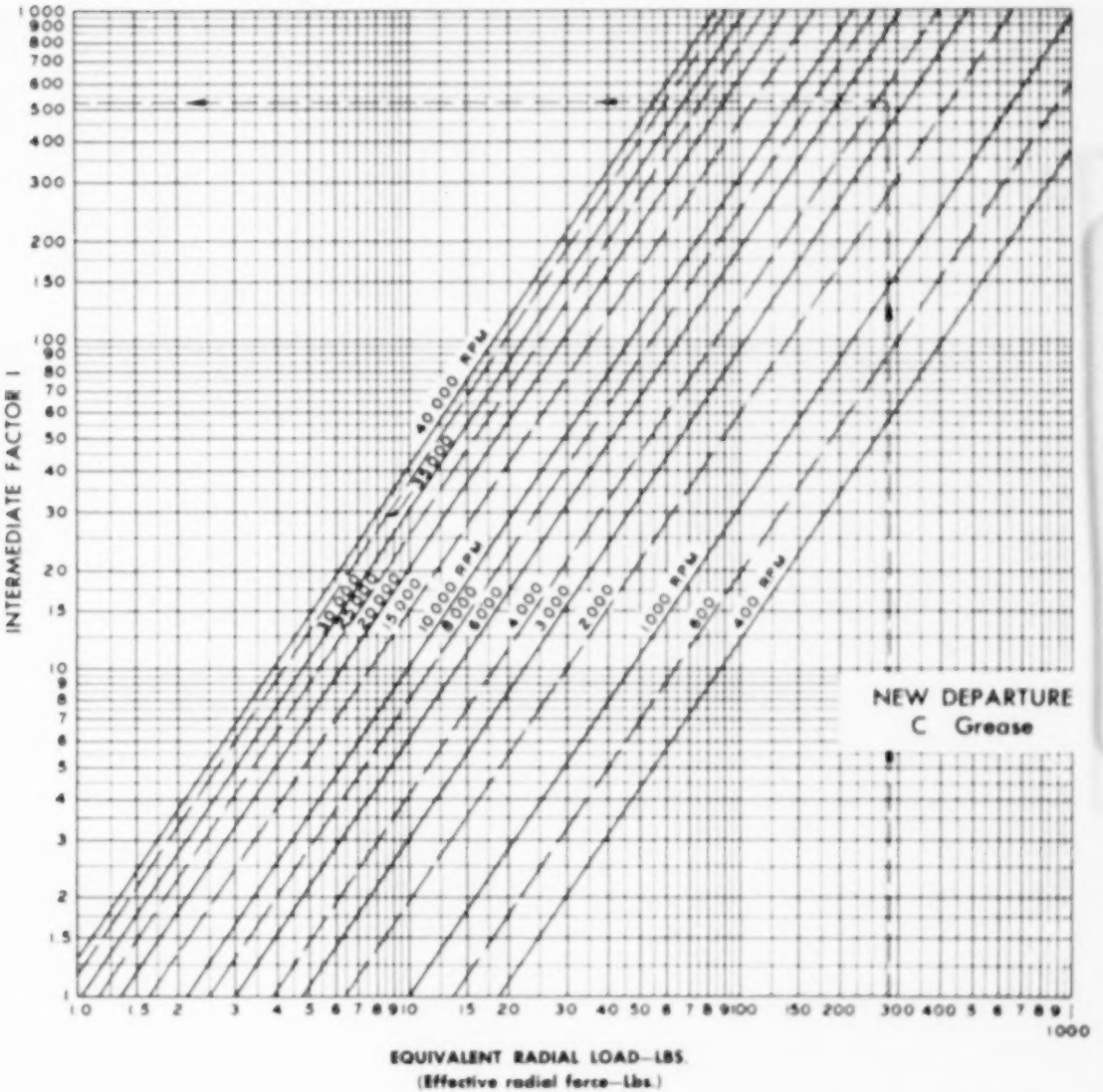


TABLE 3

TEST CONDITIONS

Size	Outer Race Temperature	Inner Race R.P.M.	Load Lbs.	Test Test Life Hours	Forecast Life Hours
7107*	70-85° F.**	10,000**	0	54,000 +	32,000-48,000
77R4*	70-85**	300**	0	35,000 +	37,000-66,000
97037*	100	1,200	0	36,000	32,000
97037*	180	1,200	0	13,200	9,500
87500	140	25,500	10 Thrust	1,820	1,420
88503	250	3,000	0	2,150	2,400
88503	250	10,000	0	450	600
88503	105	3,000	220 Radial	10,770 +	11,320
88503	246	3,000	220 Radial	1,284	1,180
99505	122	3,000	525 Radial	4,700	5,000
88507	146	3,000	580 Radial	9,650	13,220
88507	141	3,000	1060 Radial	4,320	3,300
88507	158	3,000	1400 Radial	1,447	1,210
88508	91	2,000	100 Radial	34,000	32,200
77508	250**	3,000**	450 Thrust	250	980
3312	212	1,800	150 Radial	4,000 +	5,320
1316 1318	80-120	1000-3000	0-3000	41,000 +	15,000-41,000

*Field Tests

**Outer Race Rotated—Inner Race Temperature

FATIGUE LIFE VS. GREASE LIFE FAILURE DISTRIBUTION — RELUBRICATION INTERVALS

Prelubricated bearings are most often applied where load factors are high so that normal, or fatigue life is very long and grease breakdown may determine the service life of the bearings. However, with a load factor of less than 2, conditions of operation can be such that grease life exceeds fatigue life, in which case usefulness is terminated by the latter.

Because of this possibility, it is advisable where load factors are less than 2 to calculate for both grease breakdown and fatigue life.

For New Departure ball bearings,

$$\text{Fatigue Life in Hours} = \left(\frac{\text{rated load capacity}}{\text{work load}}\right)^3 \times 3800$$

Grease and fatigue lives are averages expected from groups of bearings. Life will vary with individual bearings, and this variation is different for grease breakdown than it is for fatigue failure. Consideration of this difference in failure distribution, tabulated below, is advisable, and particularly that below the average.

TABLE 4

Per Cent of Bearing Group Which Will Exceed Various Percentages of Average Life

% Ave. Life	10	20	40	60	80	100
Grease	100%	100%	96%	80%	63%	46%
Fatigue	95%	90%	75%	60%	50%	38%

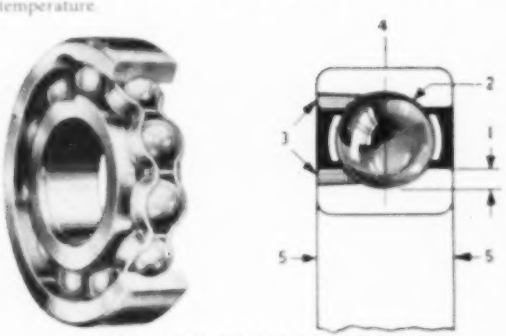
Where relubrication may be required, an interval of 40 per cent of the average life is recommended so as to minimize possibility of failure and at the same time allow a long period between lubrications.

BEARING TYPES OTHER THAN SINGLE ROW, NON-FILLING SLOT, OPERATING UNDER LOAD

Rolling friction and the heat generated importantly affect grease life. The amount of friction and the indeterminate temperature it generates in the working grease are, in turn, affected by the distribution and intensity of load on individual balls and the amount of bearing metal available to conduct heat away from the load track.

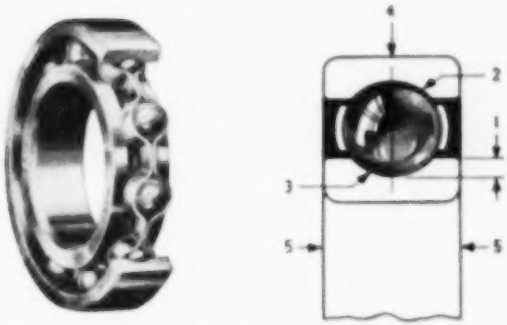
From this it can be seen that differences in dimensions, contact angle and number of balls in the various bearing types will cause variations in greased bearing life although the work load, r.p.m., and stationary ring temperature may be the same.

In the following, bearings of different types are compared to single row radial, non-filling slot bearings of like bore and O.D. and under the same load, speed and stationary ring temperature.



SINGLE ROW WITH FILLING SLOT

1. *Deep closely conforming ball raceways.*
2. *Largest number of balls of maximum diameter commensurate with strength of bearing section.*
3. *Loading grooves, accurately gauged and located so ball pressure areas do not impinge upon them under recommended loads.*
4. *Maximum single row radial capacity.*
5. *Moderate thrust resisted from either direction when in combination with radial load.*



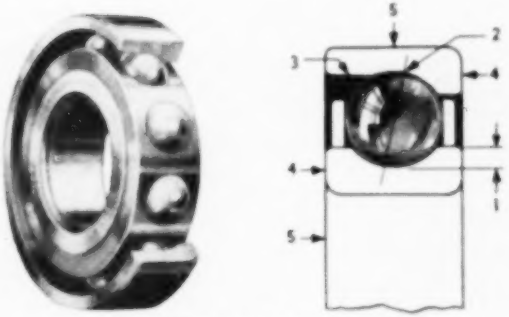
SINGLE ROW, NON-FILLING SLOT

1. *Deep, uninterrupted ball raceways.*
2. *Largest size balls compatible with adequate race sectional depth at heaviest stressed points.*
3. *Accurately generated raceways, closely conforming to ball curvature.*
4. *Capacity for heavy radial loads.*
5. *Capacity for combined loads with thrust loads from either direction.*

SINGLE ROW, FILLING SLOT TYPE

Greater grease life can be expected, since a more favorable distribution of load results from the larger number of balls.

1. *Close conforming ball raceways, with high shoulders for correct support under combined loads.*



SINGLE ROW ANGULAR CONTACT

2. *Balls contact raceways at a predetermined angle from vertical plane of bearing.*
3. *Low shoulder on one side of outer ring for introduction of maximum number and size of balls.*
4. *Thrust faces of inner and outer rings.*
5. *Capacity for heavy combined loads, with thrust from one direction.*

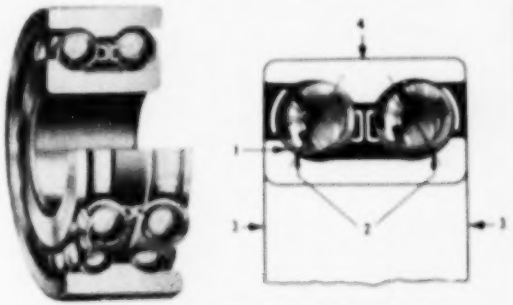
SINGLE ROW ANGULAR CONTACT

Under small load angles, grease life would be expected to approximate that of single row radial, non-filling slot bearings since the larger number of balls tends to balance out the adverse effect of contact angle on ball loads.

With greater contact angles and large load angles, the effect is to reduce ball loads, therefore, longer grease life may be expected than for radial bearings.

DOUBLE ROW BEARINGS

Under small load angles double row (angular contact) bearings would be expected to give substantially longer grease life, since a definitely more favorable distribution of load occurs on the two rows of balls.



DOUBLE ROW ANGULAR CONTACT

1. *Maximum number of large balls, supported by close conforming, high shouldered raceways.*
2. *Balls and races in firm angular contact under a fixed internal preload.*
3. *Heavy thrust resisted from either direction.*
4. *Rigid radial support for heavy loads.*

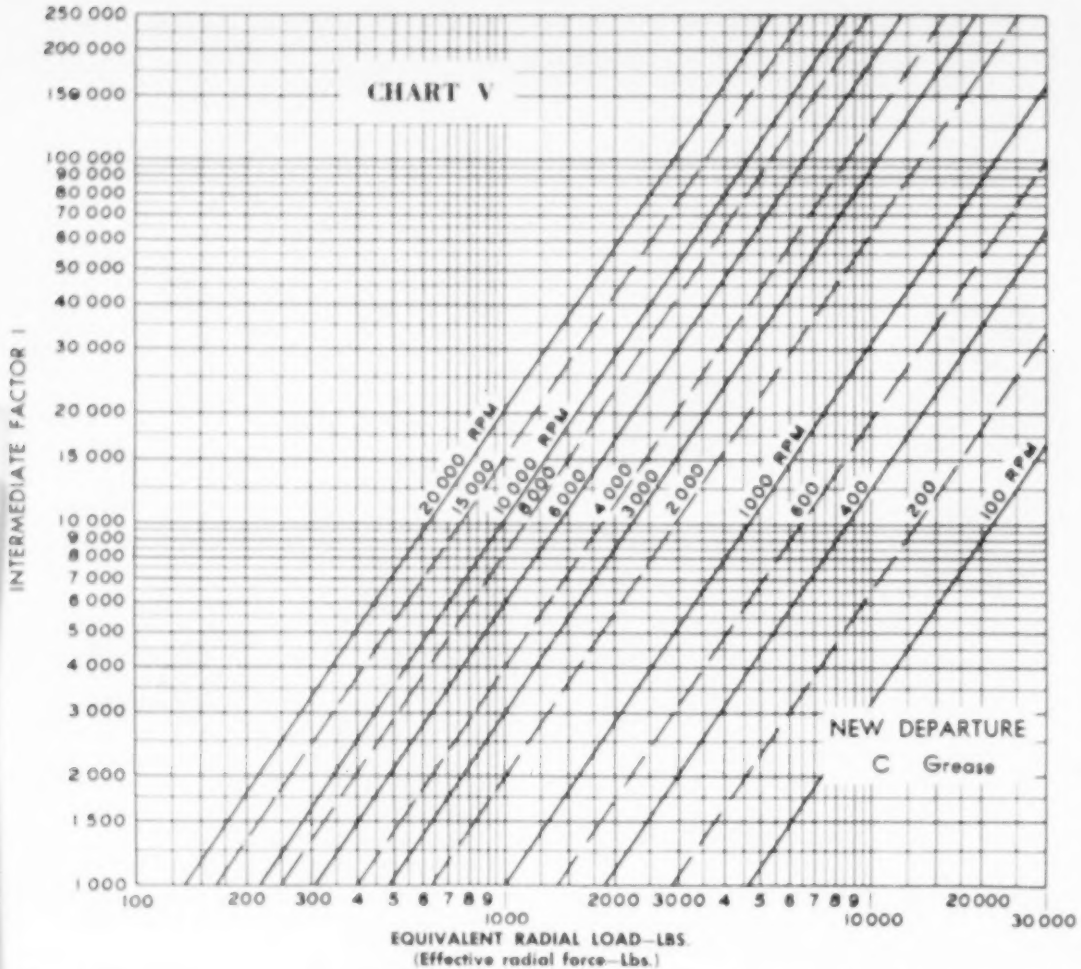
In a test of 55506 (shielded on both sides) double row bearings under heavy radial load, three times the grease life was obtained over that anticipated for 77506 single row bearings.

Under large load angles, although one row of balls is taking most of the load, longer life is to be expected since the high contact angle acts to reduce ball loads.

BALL RACE CURVATURE

Nominal curvatures for inner and outer ring ball races are 51.6 and 53 per cent respectively. With a bearing running under negligible load, race curvature has no material effect on life.

However, operating under load, bearings with open curvatures will develop lower rolling friction and give longer life,



whereas close curvature results in greater friction and reduced grease life.

OUTER RING ROTATION

Available experience indicates that outer ring rotation affects grease life to a greater extent than does inner ring rotation, particularly at high operating temperatures.

A "rule of thumb" recommended is that outer ring rotation has little effect at low inner ring temperature (close to room) and at low speeds. But, grease life may be less than one-half that for inner ring rotation where outer ring rotates and the stationary ring temperatures are near 250° F. and speeds are moderate to high.

"NEW DEPARTURE" BEARING NUMBERING

Most standard New Departure Ball Bearings conform to a system of numbering, which, once understood, makes it possible to identify the principal characteristics of a bearing by the digits in the number.

Reading from the right, the first two digits give the bore size, the third digit shows the series, while the fourth, fifth and sixth digits indicate the basic bearing type and identify additional features, such as shields or snap rings.

For instance, 1, in the third digit place means extra light series, 2, means light series, 3, medium series, 4, heavy series, 5, non-loading groove light series, 6, non-loading groove medium series.

For the fourth digit, 0, means angular contact type; 1, means single row maximum capacity type; 3, single row non-loading groove; 5, double row; 7, shielded type; 8, N-D-Seal type, and 9 means a sealed bearing in single row width.

As a typical example, the number 8506 indicates a 6 bore, light series, N-D-Seal bearing. Number 88506 is the same, but with seals on both sides, while number 488506 is the latter bearing with a snap ring added. In the case of double row bearings, 5 or 6 as the third digit indicates shielded, light or medium series.

DESCRIPTION	BEARING NUMBER					
	Type		Series		Bore	
	6th	5th	4th	3rd	2nd	1st
Angular contact, extra light, 12 bore			0	1	1	2
Flanged ang. con., extra light, 14 bore		N	0	1	1	4
Max. capacity single row radial, light series, 6 bore			1	2	0	6
Max. capacity, single row radial, medium series, 6 bore			1	3	0	6
Non-load. groove, single row radial, extra light, 7 bore			3	1	0	7

(Continued on Page 20)

Intermediate Factor I -- New Departure C Grease

TABLE 5

Load-Speed Factor	NO. 30 SERIES					
	30	31	36	37	38	39
1.0	0	0	0	0	0	0
.9	2.1	3.3	3.3	5.3	5.3	9.0
.8	4.5	4.7	4.7	11.6	11.6	19.6
.7	7.1	11.4	11.4	18.2	18.2	30.7
.6	10.1	16.3	16.3	26.0	26.0	44.2
.5	13.7	22.2	22.2	35.4	35.4	60.0
.4	18.4	29.6	29.6	47.2	47.2	80.0
.3	24.9	38.4	38.4	61.5	61.5	104.0
.2	32.2	51.8	51.8	82.5	82.5	140.0
.1	46.0	74.0	74.0	118.0	118.0	200.0
.05	59.7	96.3	96.3	153.5	154.0	260.0

EXTRA LIGHT SERIES (By Bore Number)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.9	9	11	17	23	43	58	92	130	184	252	310	450	522	598	811	1260	1840	2270
.8	20	24	37	51	93	127	201	284	402	548	677	980	1132	1300	1760	2740	4020	4950
.7	31	38	58	80	146	200	316	447	631	864	1070	1540	1780	2040	2770	4310	6320	7780
.6	44	54	83	115	210	288	453	640	906	1240	1480	2210	2560	2940	3970	6200	9060	11130
.5	60	73	112	156	284	390	615	870	1230	1680	2000	3000	3480	4000	5300	8400	12300	15000
.4	80	98	150	208	380	520	820	1160	1640	2240	2680	4000	4640	5320	7200	11200	16400	20200
.3	104	127	195	270	492	676	1065	1510	2130	2910	3480	5200	6030	6910	9360	14550	21300	26250
.2	140	171	262	364	665	910	1435	2030	2870	3930	4680	7000	8120	9300	12600	19600	28700	35350
.1	200	245	375	520	950	1300	2050	2900	4100	5620	6700	10000	11600	13300	18000	28000	41000	50500
.05	260	318	488	675	1235	1690	2665	3770	5330	7300	8720	13000	15100	17300	23400	36400	53300	65700

LIGHT SERIES (By Bore Number)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.9	14	18	24	38	62	89	148	229	315	391	468	643	845	1145	1320	1885	2565	3320
.8	31	40	55	83	135	193	323	500	686	863	1020	1400	1860	2500	2875	4070	5460	6600
.7	49	63	85	129	212	302	505	784	1075	1340	1600	2200	2920	3930	4520	6380	10130	14750
.6	71	91	119	185	305	437	730	1135	1545	1920	2300	3160	4200	5650	6470	9160	14550	21200
.5	96	123	162	252	414	593	990	1530	2100	2605	3120	4280	5700	7640	8800	12420	19750	28800
.4	128	164	216	336	552	790	1320	2040	2800	3480	4170	5720	7620	10180	11720	16600	26400	38400
.3	166	213	281	437	718	1020	1710	2650	3640	4520	5400	7440	9780	13200	15250	21600	34300	49800
.2	224	287	378	587	967	1350	2310	3570	4900	6090	7290	10000	13500	17860	20500	28000	46200	67200
.1	320	410	540	840	1350	1875	3300	5100	7000	8700	10400	14300	19000	25500	29300	41500	66000	96000
.05	416	532	702	1090	1750	2565	4290	6630	9100	11300	13500	18600	24700	33100	38100	54000	85790	124800

MEDIUM SERIES (By Bore Number)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.9	25	30	45	63	89	119	243	348	508	710	967	1380	1840	2135	2670	3910	5400	6430
.8	46	56	98	135	193	259	530	760	1105	1550	2105	2790	3580	4660	5780	8530	10850	12300
.7	86	104	154	218	309	407	832	1190	1740	2440	3310	4380	5620	7320	9100	13400	18500	22800
.6	121	149	221	309	437	588	1190	1710	2500	3490	4750	6300	8070	10500	13050	19200	26600	31300
.5	165	202	300	420	592	795	1620	2320	3390	4730	6450	8560	10950	14220	17700	26100	36000	56100
.4	220	270	400	561	790	1060	2160	3100	4520	6320	8600	11400	14600	19000	23600	34800	48100	74000
.3	286	351	520	730	1025	1375	2810	4030	5870	8200	11150	14820	19000	24650	30650	45200	62500	97200
.2	385	472	700	980	1382	1850	3780	5420	7910	11030	15020	19900	25500	33300	41250	61000	84100	131000
.1	550	675	1000	1400	1975	2650	5400	7750	11300	15800	21500	28500	36500	47400	59000	87000	120000	187000
.05	715	878	1300	1820	2570	3440	7020	10050	14700	20550	28000	37000	47400	61500	76750	113000	156000	243000

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(*Continued from Page* 18)

DESCRIPTION	BEARING NUMBER Type 6th	5th	4th	Series 3rd	Bore 2nd	1st
Non-load. groove, single row radial, light series, 7 bore		3		2	0	7
Non-load. groove, single row radial, medium series, 7 bore		3		3	0	7
Single seal, non-load. groove, single row, standard width, light series		9		5	0	7
Double seal, non-load. groove, single row, standard width, light series	9	9		5	0	7
Double row, extra light, 14 bore		5		1	1	4
Double row, light series, 10 bore		5		2	1	0
Double row, medium series, 10 bore		5		3	1	0
Single shield, max. cap., single row radial, light, 12 bore		7		2	1	2
Double shield, max. cap., single row radial, light series, 12 bore	7	7		2	1	2
Single shield, non-load. groove, single row, light series, 9 bore		7		5	0	9
Double shield, non-load. groove, single row, medium series, 9 bore	7	7		6	0	9
Snap ring, maximum cap., single row rad., light series, 7 bore	4	3		2	0	7
Snap ring, single shield, maximum cap., single row, light series, 7 bore	4	7		2	0	7
Snap ring, single shield, non-load. groove, single row, light, 7 bore	4	7		5	0	7
Single seal, non-load. groove, single row, light series, 6 bore		8		5	0	6
Sealed and shielded, non-load. groove, single row, light series, 6 bore	8	7		5	0	6
Double sealed, non-load. groove, single row, light series, 6 bore	8	8		5	0	6
Snap ring, single seal, non-load. groove, single row, light, 6 bore		4	8	5	0	6
Snap ring, sealed and shielded, non-load. gr., single row, light, 6 bore	4	8	7	5	0	6
Snap ring, double seal, non-load. gr., single row, light, 6 bore	4	8	8	5	0	6
Single shield, double row, light series, 7 bore			7	5	0	7
Single shield, double row, medium series 7 bore			7	6	0	7
Double shield, double row, medium series, 7 bore		7	7	6	0	7

GREAS-EVENTS

Here is a feature you can reproduce in your own publication. An electro can be made from this drawing to fit your particular page. Tell the story of your industry in picture form.

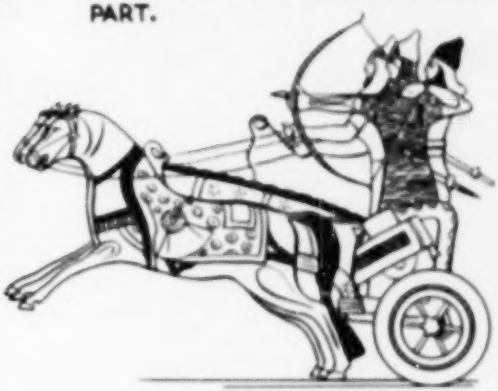
Greas-Events

THE FIRST TAXICAB –

IN 1521 THIS SNAPPY OUTFIT WAS INVENTED -- IT EVEN HAD A METER. THE LUBRICATING GREASE USED THEN WAS JUST AS FAR BEHIND TODAY'S PRODUCT AS THIS EARLY CAB IS BEHIND ITS MODERN COUNTERPART.

THIS ANCIENT EGYPTIAN

TRAVELLED AT 5 MILES PER HOUR IN THIS OPEN JOB. ITS AXLES WERE LUBRICATED WITH ANIMAL FAT -- GOOD ENOUGH FOR THAT DAY. MODERN SPEEDS REQUIRE LUBRICATING GREASES MANUFACTURED WITH LABORATORY PRECISION.



MODERN LUBRICATING GREASE –

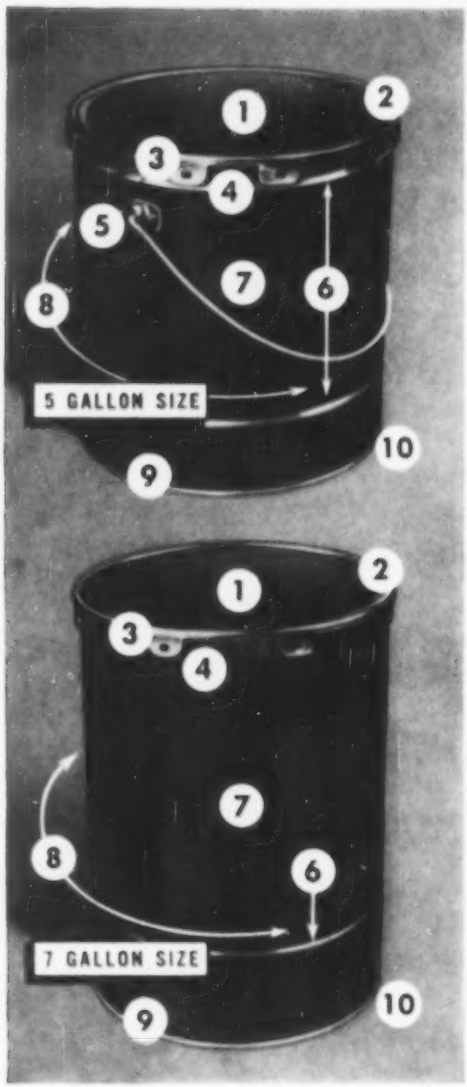
WITHOUT PRECISION MANUFACTURED LUBRICATING GREASES, TODAY'S HIGH SPEEDS WITH SAFETY WOULD BE IMPOSSIBLE. WITHOUT THEM THE AVERAGE FAMILY CAR COULDN'T TRAVEL 10,000 MILES A YEAR WITHOUT GRINDING TO A STOP OR ENDING IN AN ACCIDENT.

MODERN SERVICE STATIONS

BENEFIT ALSO -- A CAR RECEIVING A LUBRICATING GREASE JOB MEANS A TBA CUSTOMER IN THE STATION BUYING ACCESSORIES WHILE WAITING.

Check these 10 Continental features

before you buy pails for dry and viscous products



√ (1) Circular panel in cover gives greater rigidity and allows firm stacking of filled pails.

√ (2) Cover has deep gasket groove and full skirt — provides sure seal and if desired, permits use of a gasket.

√ (3) Lugs on cover are full length with punched slots — giving safer sealing and easier opening. Shipping tags can be attached through slot.

√ (4) A small embossment over each lug prevents jamming and sticking of covers during shipment or in storage.

√ (5) Ears on 5 gallon size are rigidly riveted to body and doped to prevent leakage. Pail has a heavy wire bail.

√ (6) Outward bead near top (5 gal.) and inward bead near bottom give a stronger, more rigid body.

√ (7) Pails are made of 28 gauge cold rolled steel throughout. Bodies are made of 2 panels, press locked and doped — insuring a sturdy, tight container.

√ (8) Both front and back panel of body can be attractively lithographed with sales message.

√ (9) Bottom is compound lined and has a 5 thickness seam, adding strength to pail.

√ (10) Bottom bead prevents pails from jamming too tightly when nested in shipment and storage.

Add up these ten Continental features and you have a high quality flaring pail, perfectly suited for packaging either dry or viscous products. Made in both 5 and 7 gallon sizes, Continental flaring pails serve as strong, protective containers for your products, yet they are light and easy to handle. They nest snugly—save storage space and freight costs (5,000 to 8,000 per 40' car). And to top it off, they can be attractively lithographed with your sales message to make your product stand out wherever they are displayed.

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WE'LL SEE YOU OCTOBER 30, 31, and

1950 - FUTURE MEETINGS OF YOUR INDUSTRY

OCTOBER

1-3 Independent Petroleum Assn. of America (annual meeting) Jefferson Hotel, St. Louis, Mo.

1-5 American Inst. of Electrical Engineers (district No. 2), Lord Baltimore Hotel, Baltimore, Md.

11 American Iron and Steel Inst. (regional technical meeting), Hotel William Penn., Pittsburg, Pa.

12-13 Indiana Independent Petroleum Assn. (fall convention) Hotel Severin, Indianapolis, Ind.

16-18 Socy. of Automotive Engineers (transportation meeting) Hotel Statler, New York, N. Y.

16-20 National Safety Congress Chicago, Ill.

16-21 Oil Progress Week

19-22 Permian Basin Oil Show, Odessa, Texas

20-21 American Management Assn., Hotel Statler, New York, N. Y.

OCTOBER (cont.)

23-27 American Inst. of Electrical Engineers (fall general meeting), Skirvin Hotel, Oklahoma City, Okla.

23-27 National Metal Exposition Amphitheatre, Chicago, Ill.

24-25 South Dakota Independent Oil Men's Assn. Aberdeen Civic Arena, Aberdeen, S. D.

25 American Iron and Steel Inst. (regional technical meeting), Hotel Thomas Jefferson, Birmingham, Ala.

30 to Nov. 1 NATIONAL LUBRICATING GREASE INSTITUTE (annual meeting) Edgewater Beach Hotel, Chicago, Ill.

31 Oil Trades Assn. of New York, Waldorf-Astoria Hotel, New York, N. Y.

NOVEMBER

2-3 Socy. of Automotive Engineers (diesel engine meeting) Hotel Knickerbocker, Chicago, Ill.

3-4 Socy. of Rheology (annual meeting) Hotel New Yorker, New York, N. Y.

9-10 Socy. of Automotive Engineers (fuels and lubricants meeting) Mayo Hotel, Tulsa, Okla.

10 American Iron and Steel Inst. (regional technical meeting), Hotel Mark Hopkins, San Francisco, Calif.

11-13 OIL INDUSTRY INFORMATION COMMITTEE Biltmore Hotel, Los Angeles, Calif.

13-14 AMERICAN PETROLEUM INSTITUTE (Lubrication Committee), Biltmore Hotel, Los Angeles, Calif.

NOVEMBER (cont.)

13-16 AMERICAN PETROLEUM INSTITUTE (30th annual meeting) Biltmore Hotel and the Ambassador, Los Angeles, Calif.

13-17 Nat'l. Electrical Manufacturers Assn., Chalfonte-Haddon Hall, Atlantic City, N. J.

26 to Dec. 1 American Socy. of Mechanical Engineers Hotel Statler, New York, N. Y.

27-29 American Standards Assn. Waldorf-Astoria Hotel, New York, N. Y.

27 to Dec. 2 19th Exposition of Power and Mechanical Engineering Grand Central Palace, New York, N. Y.

DECEMBER

3-6 American Inst. of Chemical Engineers (annual meeting), Neal House, Columbus, Ohio

4-5 Oil Industry TBA Group (1950 meeting), Edgewater Beach Hotel, Chicago, Ill.

26-31 American Assn. for the Advancement of Science (annual meeting) Hotel Statler, Cleveland, Ohio

★

1951—Future Meetings Of Your Industry

JANUARY, 1951

8-9 Kansas Oil Men's Assn. (Annual Convention), Lassen Hotel, Wichita

8-12 Socy. of Automotive Engineers (annual meeting and Engineering display) Hotel Book-Cadillac, Detroit, Mich.

22-26 American Inst. of Electrical Engineers (winter general meeting), Hotel Statler, New York, N. Y.

AT THE N.L.G.I. 18th ANNUAL MEETING
NOVEMBER 1 - EDGEWATER BEACH HOTEL - CHICAGO, ILLINOIS
BE SURE YOU HAVE YOUR RESERVATION!

25-26 Northwest Petroleum Assn. (annual convention), Nicollet Hotel, Minneapolis, Miss.

FEBRUARY, 1951

20-21 Kentucky Petroleum Marketers Assn. (annual meeting, convention, and trade show), Brown Hotel, Louisville, Ky.

27-28 Wisconsin Petroleum Assn. (annual convention and equipment show), Milwaukee Auditorium, Milwaukee, Wisc.

5-7 Manufacturers Standardization Socy. of the Valve & Fittings Industry (annual meeting), Commodore Hotel, New Yark, N. Y.

6-8 Socy. of Automotive Engineers (passenger car, body, and materials meeting), Hotel Book-Cadillac, Detroit, Mich.

7-9 AMERICAN PETROLEUM INSTITUTE (Division of Production, Southwestern district meeting), Hotel Beaumont, Beaumont, Texas

8-9 Indiana Independent Petroleum Assn. (spring convention and refiners and suppliers exhibit). Hotel Severin, Indianapolis, Indiana

APRIL, 1951

11-13 American Inst. of Electrical Engineers (district No. 4 meeting), Miami, Fla.

16-18 Socy. of Automotive Engineers, (national aeronautic meeting and aircraft engineering display), Hotel Statler, New York, N. Y.

16-18 American Socy. of Lubrication Engineers (annual convention—annual lubrication show) Bellevue-Stratford Hotel, Philadelphia, Pa.

18-20 National Petroleum Assn. Hotel Cleveland, Cleveland, Ohio

23-24 Industrial Accident Prevention Assn. (annual convention), Royal York Hotel, Toronto, Can.

30 to May 3 AMERICAN PETROLEUM INSTITUTE (Division of Refining, 16th mid-year meeting). Mayo Hotel, Tulsa, Okla.

MAY, 1951

2-4 American Inst. of Electrical Engineers (district No. 1 meeting), Syracuse, N. Y.

7-10 National Fire Protection Assn., Detroit, Michigan

12-16 National Fire Protection Assn., Montreal, Quebec

13-16 American Inst. of Chemical Engineers (regional meeting), Hotel Muehlebach, Kansas City, Mo.

24-25 American Inst. of Electrical Engineers (district No. 5 meeting), Madison, Wisc.

28-29 AMERICAN PETROLEUM INSTITUTE (Division of Marketing, mid-year meeting). Cincinnati, Ohio.

JUNE, 1951

18-22 American Socy. for Testing Materials (annual meeting), Atlantic City, N. J.

SEPTEMBER, 1951

12-14 National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

26-28 National Metal Trades Assn. Palmer House, Chicago, Ill.

NOVEMBER, 1951

5-8 AMERICAN PETROLEUM INSTITUTE Stevens-Palmer House, Chicago, Ill.

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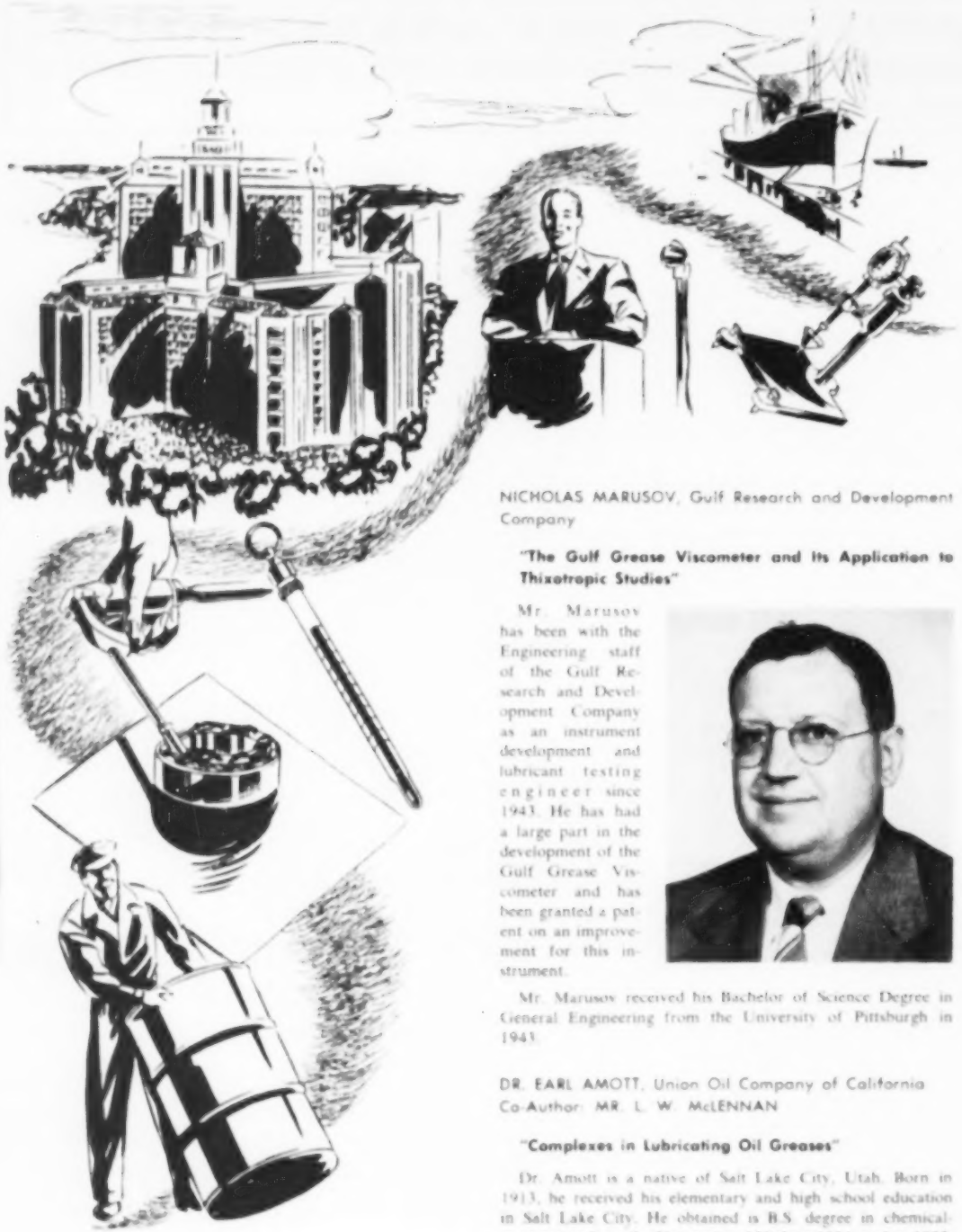

NICHOLAS MARUSOV, Gulf Research and Development Company

"The Gulf Grease Viscometer and Its Application to Thixotropic Studies"

Mr. Marusov has been with the Engineering staff of the Gulf Research and Development Company as an instrument development and lubricant testing engineer since 1943. He has had a large part in the development of the Gulf Grease Viscometer and has been granted a patent on an improvement for this instrument.

Mr. Marusov received his Bachelor of Science Degree in General Engineering from the University of Pittsburgh in 1943.

DR. EARL AMOTT, Union Oil Company of California
Co-Author: MR. L. W. McLENNAN

"Complexes in Lubricating Oil Greases"

Dr. Amott is a native of Salt Lake City, Utah. Born in 1913, he received his elementary and high school education in Salt Lake City. He obtained is B.S. degree in chemical engineering from the University of Utah in 1934, and in 1935,

N. L. G. I. *18th Annual Meeting*

EDGEWATER BEACH HOTEL

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OUTSTANDING SPEAKERS

he was awarded his M.S. degree.

The period from 1935 to 1939 was spent in graduate work at the University of Wisconsin where Arnott received his Ph.D. in Chemistry.

Since 1939 Dr. Arnott has been associated with the Union Oil Company of California, where he has been on lubricating oils and greases.

MR. WALTER K. DEAN, Mallinckrodt Chemical Works

"Comments on Structure of Aluminum Greases"

Mr. Walter K. Dean was awarded his M. S. degree from the Missouri School of Mines and Metallurgy in 1941. He received his B. S. degree in Chemistry from the University of Wisconsin in 1939.

Following his graduation in 1941, he joined the technical staff of Mallinckrodt Chemical Works. For the past eight years he has been engaged in research and development work on the metallic soaps. The past five years Mr. Dean has also handled technical service projects connected with the sale of metallic soaps.

Mr. Dean, a native of Montana, is a member of Sigma Xi and the American Chemical Society.

L. W. McLENNAN, Research Department, Union Oil Company of California

Co-Author: DR. EARL ARNOTT

"Complexes in Lubricating Oil Greases"

Mr. McLennan was born in Canada in 1900 and received his elementary and high school education in Vancouver, Canada. After completing his undergraduate work in chemistry, he graduated (B. A.) from the University of British Columbia in 1922.

The following three years (1922-1925) were spent at Oxford University in England, doing graduate research work. After receiving his B.S. degree from Oxford in 1925, Mr. McLennan became associated with the research group of the Koppers Co. in Pittsburgh, Pa.

During 1927-1928, Mr. McLennan held a teaching fellowship at the University of California.

In 1928, he returned to industrial work with the Research Department of the Union Oil Co. of California and has been associated with this firm since that time.

At the present time, he directs the company's research laboratory at Oleum and in particular supervises research on greases. Mr. McLennan is a member of the American Chemical Society and the A.S.T.M.

MR. L. G. ROTTER, Chief Engineer, Lincoln Engineering Company

"A Plea for Uniformity in the Packaging of Lubricating Greases"

Mr. L. C. Rotter holds certificates in both Mechanical and Electrical Engineering from Washington University, having completed approximately twelve years of extension courses.

He started his engineering career at Century Electric Company in 1923 as an apprentice, receiving training in the shop as well as in Engineering.

Mr. Rotter became associated with lubricating equipment when he joined the engineering staff of the Lincoln Engineering Company.

In 1937 he was appointed Lincoln Engineering's Chief Engineer, which is the position he still holds. He is a registered Professional Engineer in the state of Missouri, and a member of the S.A.E. and A.S.M.E.

MR. CHARLES J. BONER, Chief Research Chemist, Battenfeld Grease & Oil Corporation

"Influence of Chemical Structure of Lubricating Oil on the Manufacture of Lubricating Grease"

Charles J. Boner was educated at the University of Missouri where he received a degree in Chemical Engineering.

Mr. Boner has been with Battenfeld Grease & Oil Corporation for the past twenty-three years, and for the past fourteen years has had charge of Research and Development for this company. He is a member of the American Chemical Society and the American Society of Lubricating Engineers. He is also active in committee work with the American Society of Testing Materials.

The Marquis publication of "Who Knows—and What" lists Mr. Boner as an authority on lubricating greases and metallic soaps. He will also be listed in the coming edition of "Who's Who in the Midwest."

MR. ALEX C. SOMMERS, Manager Lubrication Sales, Richfield Oil Corporation of New York

"Multi-Purpose Grease-Economics and Human Reaction in the Automotive Field"

Since 1934 Mr. A. C. Sommers has been associated with Richfield Oil Corporation of New York, working in Products Control and Lubrication Sales. He is now Manager, Lubrication Sales.

Mr. Sommers began his career in the U. S. Navy, World War I, as Chief Machinist Mate, Destroyer and Submarine Service. Later he was associated with the White Motor Company for nine years, working in Service—Service Sales. Prior to his present affiliation, he served four years as Combustion Engineer and Fleet Consultant of the Gulf Refining Company.

Mr. Sommers spent three years at Lehigh University, studying chemical engineering.

MR. H. C. ZWEIFEL, Research Supervisor, Richfield Oil Corporation

"Development of Thread Sealing Compounds"

Mr. H. C. "Pat" Zweifel was graduated in chemistry in 1932 from the University of Southern California.

Upon his graduation, he was employed in research work by the Shell Oil Company and the Shell Petroleum Corporation until 1935.

From 1936 to the present time he has been with the Richfield Oil Corporation in various positions in the laboratories and refining operations; being in charge of the Grease Manufacturing and Oil Compounding Plant for two years. For the past twelve years his time has been devoted to the development of asphaltic products and lubricants.

Mr. Zweifel is currently in charge of the Lubricants Research Laboratories, and cooperates in a technical capacity with the Products Research and Development and Lubricating Sales Department.

MR. W. J. MONGON, Imo—De Laval Products Division, De Laval Steam Turbine Company

"Rotary Pumps—Basic Considerations in Their Application"

Mr. W. J. Mongon received his B. S. degree in Mechanical Engineering from Drexel Institute, Philadelphia, Pa. in 1928.

Born, 1904, and raised in Trenton, New Jersey, Mr. Mongon returned to Trenton after his graduation.

At Trenton he was employed by the De Laval Steam Turbine Company, and has remained with them, except for an interlude of about four years—from 1930 to 1934, when he was employed by the Westinghouse Lamp Company.

During his experience with De Laval, Mr. Mongon has worked through the test floor, drafting rooms, service department, turbine application and IMO pump division. He has been with the latter division since 1934, and has been engaged primarily in the design and application.

JOHN M. MUSSELMAN, Cleveland Lubricating Oil Plant, Standard Oil Company (Ohio)

"The Effect of Soap Compounds on the Physical Properties of Soda-Base Greases"

Mr. John M. Musselman was born in Wooster, Ohio, and received his Bachelor of Science degree in Chemistry at the College of Wooster in the year 1926.

Shortly after graduation, he joined the Standard Oil Company (Ohio) at their Cleveland Lubricating Oil Plant as chemist. His efforts were largely engaged in the development of improved motor oils, greases, and waxes. He has been granted over 45 patents in the lubricating oil field.

At the present time, Mr. Musselman is supervisor of his Company's Lubricating Oil Development Section.

Mr. Musselman is a member of the American Chemical Society and is actively interested in both N.L.G.I. and A.S.T.M. grease activities.

MR. EDWARD M. GLASS, Headquarters Air Material Command, Wright-Patterson Air Force Base

Co-Author: MR. BERNARD RUBIN

"Evaluation and Use of Synthetic Greases"

Mr. Edward Glass is a graduate of the Rhode Island State College, and has done work towards his Masters Degree at Virginia Polytechnic Institute.

After working as a soils chemist for the Soils Conservation Service for a short time in 1941, Mr. Glass transferred to the War Department early in 1942.

He was assigned to Wright Field as an aircraft maintenance supervisor in the Air Service Command. This job consisted in the main of "trouble shooting" on fuels and lubricants problems.

In 1945 Mr. Glass entered the Army as an enlisted man.

After release from the Air Force, he re-entered the government service and was appointed Assistant Chief, Chemical Branch of the Wright Field Materials Laboratory, in addition to the duties of Chief, Petroleum Products Unit.

MR. BERNARD RUBIN, Air Material Command, Wright-Patterson Air Force Base

Co-Author: MR. E. M. GLASS

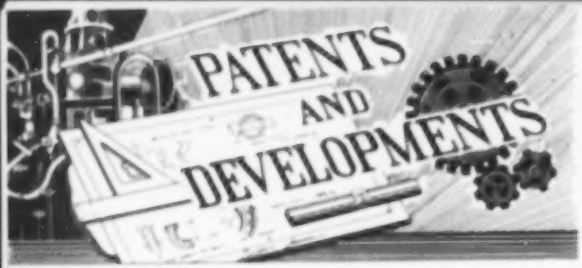
"Evaluation and Use of Synthetic Greases"

A native of Brooklyn, New York, Mr. Rubin was born in 1917. He was graduated in chemistry from the City College in 1940. Since 1940 he has done considerable graduate work in chemical engineering at Ohio State University.

After graduation, Mr. Rubin worked in the field of dye chemistry for a year.

In 1942 he entered the service of the Air Force as a civilian instructor in the ground maintenance of aircraft. In a four year period, he covered the airframe and engine operation.

Since 1946 he has been with the Materials Laboratory, Engineering Division, at Wright Field and has been placed in charge of grease development and evaluation.

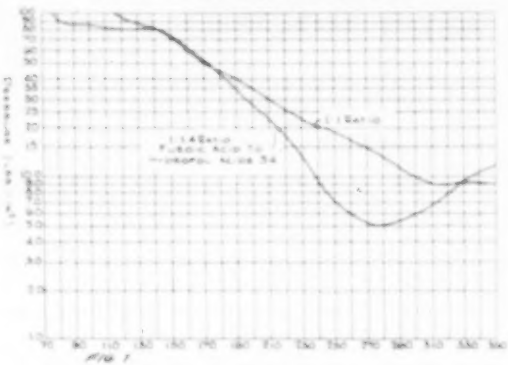


HIGH TEMPERATURE STABLE GREASES—Grease compositions suitable for high temperature use and capable of retaining their structure at high temperatures over extended periods of time are disclosed in U.S. Patent 2,516,136 to Standard Oil Development Co. Use has been made of metal salts of organic acids of low molecular weight with conventional metal soaps to improve stability at high temperature apparently due to the formation of a complex with superior grease thickening effect than the soap itself. Such improvement by low molecular weight salts is noticed particularly with alkali and alkaline earth metal soap bases. Acrylic and crotonic acids are also low molecular weight acids which show superiority in this respect but they are relatively expensive. In the present patent, disclosure is made of the use of furoic acid salts for this purpose and it is pointed out that this acid is relatively inexpensive. The metallic element of the salts and soaps is preferably sodium and lithium in the alkali metal series and calcium in the alkaline earth metallic series, mainly because of low cost. The most satisfactory proportions are generally about 1:1 salt of low molecular acid to soap employed. For a stiff grease composition, the total quantities of soap and salt may approach 50% of the weight of the final composition, whereas for a soft grease the amount may be as low as 5%. These greases consist of a lubricating oil having an S.S.U. at 210° F of about 35-200, containing about 3-30% by weight of metal soap of C_{12}-C_{22} fatty acids or glycerides, along with 2-20% of the metal salt of low molecular weight heterocyclic acid, preferably furoic. Certain synthetic esters such as di- 2-ethylhexyl sebacate may replace the petroleum oil. Also, oxidation inhibitors such as phenyl alpha naphthylamine, phenyl beta naphthylamine, etc. can be used to improve oxidation resistance.

One suitable grease given as an example was prepared with the following composition: 15% hydrogenated fish oil acids (substantially saturated fatty acids of 14-22 carbon atoms sold under the trade name "Hydrofol" Acids 54), 6% furoic acid, 5% sodium hydroxide, and 74% low cold test lubricating oil of 50 S.S.U. at 210° F. These materials are charged into a fire-heated grease kettle and warmed to 150-160° F. The caustic was then added in the form of 30% aqueous solution to neutralize the acids. Then, the temperature was raised to 220° F to evaporate the water and dry out the soap mixed with the furoate. After drying, the temperature was raised further to 300° F while stirring was continued until the remainder of the mineral oil was added in small proportions. After all of the oil was added, the temperature was raised to 400° F and part of the resulting grease was removed for test, the remainder being heated still further to about 480° F. The portion of the grease removed at 400° F was worked while cooling and became a smooth composition of excellent appearance and structure with penetration of 250 mm/10 and a dropping point of 468° F. The other part of the grease, which was heated to 480° F, was cooled without stirring. Thereafter, it was homogenized and found to have a penetration of 180 mm/10 with a dropping point of 510° F.

Where high soap concentrations were employed, and the fatty acid to furoic acid ratio was increased much above 1:1, such as 2:1, the grease became quite rubbery in texture at high temperature. However, this had no effect on the good properties of the grease at low or moderate temperatures. The rubbery structure becomes more pronounced in lubricants of higher soap content. However, the tendency of grease to become heavier (i.e., to increase in apparent viscosity) at higher temperatures, is desirable so long as the product does not become rubbery. Ordinary greases tend to thin out considerably at the temperatures attained in some anti- friction bearings and may not remain in the bearings if they fluidize excessively. Figure 1 shows graphically the thickening at elevated temperatures of several compositions as indicated, while Figure 2 is a comparison between 2 other compositions indicated. A comparison of the 2 sets of curves illustrates the difference between greases containing over 15% of soap (Figure 1) and those containing a lesser quantity (Figure 2). The most important difference appears to be in the lower right hand corners of the respective figures

Performance of Furoric Acid in High Grease Pressure Viscometers
(Greases with total soap content below 15%)



Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

The Editorial Subcommittee has completed its reorganization and the present membership is the following:

Dr. E. W. Adams (Chairman)—Standard Oil Company (Indiana)

Mr. T. E. DeVilliers—Cities Service Oil Company

Mr. G. W. Miller—Battenfeld Grease & Oil Company

Mr. R. K. Smith—Kendall Refining Company

Mr. Wade Adams and Mr. George Miller also served on the previous Subcommittee under the Chairmanship of Mr. Gus Kaufman. Advantage is taken of this opportunity to acknowledge the good work done by that group. One of their most important contributions was the development of "Standards for Suitability of Papers for Publication in The Institute Spokesman".*

The Panel on Delivery Characteristics of Dispensing Equipment for Lubricating Greases has a meeting scheduled for this month to discuss methods for the determination of primeability or slumpability characteristics of greases. They are ready and willing to give careful consideration to any suggestions. For ready reference, we repeat below the addresses of Messrs. R. G. Moyer and L. C. Brunstrum, to whom such recommendations should be submitted:

Mr. R. G. Moyer, The Pure Oil Company, Research & Development Laboratories, Crystal Lake, Illinois.

Mr. L. C. Brunstrum, Standard Oil Company (Indiana), P. O. Box 431, Whiting, Indiana.

You may be interested to know that the advisability of organizing a joint committee with the Committee on Lubrication of Cars and Locomotives, Mechanical Division, Association of American Railroads, is under investigation. The objective would be to study problems of mutual interest involving greases for the lubrication of railroad car journal box roller bearings. Further information regarding this proposal will be given in the next issue of this Column.

It is not too late to send to Messrs. H. L. Hemmingway, W. H. Oldacre or the writer your suggestions for items to be put on the agenda for the October meeting of the Technical Committee in Chicago.

*We wish to take this opportunity to present the following standards established by the N.L.G.I. editorial committee.

Standards for Suitability of Papers for Publication in "The Institute Spokesman"

1. Any paper accepted for publication must represent a distinct contribution to the literature on the subject either through the contribution of significant original material or by collating previously scattered or inadequately assembled information in a useful form.
2. The subject matter should be limited to lubricating greases and their principal ramifications such as research, development, manufacture, testing, equipment, application, technical service and statistical information. Papers may also represent literature surveys and philosophical or historical information.
3. All papers must be free from undue commercialism or sales propaganda.
4. Technical papers must include the necessary experimental data to justify conclusions.
5. Reproducibility of results must be amply proven.
6. Interpretations of data must be logically clear, scientifically ethical and statistically sound.
7. Where possible, correlation of experimental data with actual field performance should be attempted.
8. Papers should be written in concise, grammatically correct and easily readable style.

(Continued from page 30)

where the pressure-viscosity curve of the grease of high soap content goes up in one case and down in the other.

FURFURAL IN GREASES—Another method for incorporating furoic salts in greases involves the subjection of furfural to the Cannizzaro reaction in which furfural is heated with 33% caustic to give sodium furoate and furfuryl alcohol. Such a reaction is employed in Standard Oil Development Co.'s U.S. Patent 2,516,138, and is particularly advantageous when a raffinate oil containing 10% furfural from an extraction operation is employed as the oil for the grease. Such an oil is treated with 3.18% sodium hydroxide in aqueous solution and the ingredients are mixed in a grease kettle for an hour to allow the reaction to take place. Thereafter, 15% of fatty acid, preferably hydrogenated fish oil acids, is added together with 2.25% sodium hydroxide, sufficient to neutralize the fatty acid. Pan cooling is a part of the finishing operation. The finished grease composition should contain about 3-12% of sodium furoate. The furfuryl alcohol formed in the reaction is preferably removed from the grease either completely or to a considerable extent, during the cooking operation.

BENTONE GREASES—The production of Bentones by National Lead Co. originated with work at the Mellon Inst. Bentonite, which is principally sodium montmorillonite, is first hydrated in about 3% aqueous dispersion in water and centrifuged to remove foreign material, and a water solution of an organic base such as a quaternary ammonium or amine salt is added to precipitate the Bentone in which the sodium atoms are replaced by the organic cations. This Bentone forms grease-like gels in lubricating oils and greases so formed possess no melting points. It is estimated that the Bentone greases may eventually win more than half the market for greases, which would make Bentone requirements in the neighborhood of 50 million lbs. per year. Already, these greases are said to be competitive with barium and lithium greases (Chem. Ind. 8/50 p.180).

PRACTICAL GRIPES ABOUT GREASE—Pope (Power 7/50 p.88).

Silicone News

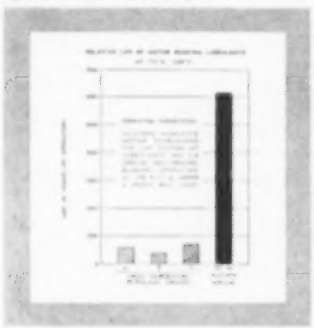
DC

IN THE BEARINGS OF ELECTRIC MOTORS

DC 44 SILICONE GREASE CAN SAVE INDUSTRY

$45,000,000.00 A YEAR!

Count the number of conventional-type motors you have in your plant. Multiply that number by $4.52 and you have the average yearly cost of lubricating those motors plus the cost of motor failure caused by improper lubrication. That cost is based on a carefully conducted study of motor lubrication and outage costs due to bearing failure in a variety of industrial plants across the country.



With an estimated 10 to 15 million motors now in service, American industry spends 45 to 67 million dollars a year that might be saved by the use of DC 44 Silicone Grease. That possibility is based on the performance of this Dow Corning Silicone grease in about half a million cartridge ball bearings used in a widely advertised line of industrial motors. Experience has proved that these bearings, prelubricated for life with DC 44, require no further attention.

That confirms the testing done by Dow Corning, by bearing manufacturers and by the military establishment. Data such as that shown above indicate that you can expect DC 44 Silicone Grease to last at least 10 times longer than high temperature petroleum greases.

For more information about Dow Corning Silicone Greases, phone our nearest branch office or write for data sheet 74-22

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GREASONALITIES

PENNSYLVANIA REFINING JOINS N.L.G.I., HODGSON AND FENKER TO REPRESENT THEM

PENNSYLVANIA REFINING COMPANY'S . . . Karns City, Pennsylvania refinery has been running Pennsylvania Crude continuously since 1879.

Early production was limited to petrolatum, kerosene and steam engine lubricants, which were about the only petroleum products used at that time.

Now, however, the completely modern refinery at Karns City and the large compounding plants at Cleveland, Ohio and Edgewater, New Jersey refine and manufacture hundreds of products under the Penn Drake brand.

DON E. HODGSON

Don E. Hodgson, of Pennsylvania's Cleveland plant and sales offices, has been appointed to membership in the National Lubricating Grease Institute, and Grafton F. Fenker will be the company's technical representative to the Institute.

Don Hodgson joined Pennsylvania Refining Company in 1948, after eight years with Warren Refining and Chemical Company. He is in charge of field sales at the Cleveland sales office.

GRAFTON F. FENKER

Grafton F. Fenker has been in charge of research and product control at the Cleveland plant since 1939. Prior to that time he had done chemical research for Otis Steel Company, U. S. Aluminum and Sherwin Williams.

WILLIAM OLDACRE . . . writes us that the statement on Petroleum Packaging appearing in Petroleum Marketer for August, 1950, is a "nice piece of publicity for which Mr. Cubicciotti and others of our N. L. G. I. group should be congratulated."

We looked up the Petroleum Marketer, and sure enough, there was more evidence of work being done by up-and-coming N. L. G. I. members.

SOUTHWEST GREASE & OIL CO. . . . is happy to announce the appointment of Mr. Harden B. Elliott, as sales representative in the Kansas City, St. Louis, Des Moines and Minneapolis areas.

Harden brings to Southwest Grease & Oil Co., twenty-three years' experience in manufacturing, marketing and engineering, in the Lubricating Grease industry. He is well known in Refiner, Compounder, and Jobber circles in the states of Missouri, Iowa, Minnesota, Indiana, Illinois and Kentucky.

H. B. ELLIOTT

Mr. Elliott is a member of the Kansas City Oil Mens Club, The Society of Automotive Engineers, The American Ordnance Society, and a member of the Masonic Lodge.

He lives in Kansas City, Missouri, with his wife, Gladys, and their six children—three boys and three girls. Mr. and Mrs. Elliott are the proud Grandparents of two lovely Granddaughters.

DR. HOLGER C. ANDERSON, . . . formerly Research and Development Director for Hastings and Company, Phil-

(Continued on page 35)

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Greasonalities

(*Continued from page 32*)

adelphia, and Mr. Lawrence J. Reader, formerly Senior Inorganic Research Chemist with General Chemical Company and Wyandotte Chemical Corporation, have joined the staff of the Research Laboratories of Foote Mineral Company, Philadelphia, Pa., it was announced recently by Dr. S. C. Ogburn, Jr., Director.

Dr. Anderson, who was for a time Research Group leader with Kellex Corporation, graduated from Northwestern University and received his Ph.D. in Physical Chemistry from Harvard. Mr. Reader received his B.S. and M.S. degrees from the University of Minnesota.

Mr. L. H. Belz and Mr. Harvey Stewart, Jr. also have been added to the Research and Development Staff.

THEY THINK IT'S WORTH IT . . . for the past several years a group composed of dispensing equipment and lubricating grease manufacturers have met at least once a year and in the meantime carried on extensive laboratory studies to determine the delivery characteristics of dispensing equipment.

Recently the N.L.G.I. office sent a letter to members of this committee asking them if the result of their studies was beneficial. Here are some of the responses—the Army Ordnance Department said: "One point of importance is the setting up of a uniform procedure method. Another beneficial effect is the exchange of ideas between the grease manufacturer—grease gun groups which will lead to closer cooperation and eventual grease-grease gun rating.

"The work of this panel has been of benefit to me in that I have a better conception of the difficulties experienced by both manufacturer and user."

An equipment manufacturer comments: "We feel our time and efforts are spent wisely and our plans are to cooperate fully with this Panel for our own benefit, for the benefit of the industry as a whole; for the consuming public; as well as the U. S. Government."

A lubricating grease manufacturer tells us: "The objective of the subject Panel on Delivery Characteristics of Dispensing Equipment is to develop a method for evaluating guns in terms of fundamental grease characteristics and thereby enable one to predict from those characteristics whether a grease can be handled by specific dispensing equipment. It is believed that considerable progress has been made by the N.L.G.I. Committee on this project and it is the hope of both grease and gun manufacturers that this work will be satisfactorily finalized in the not distant future."

Actually we received 11 letters from Panel members, most of which were enthusiastic in their praise of the Panel activities and results obtained to date.

All N.L.G.I. members recently received a 22-page report covering the findings of the Panel. A few copies are still available to N.L.G.I. members, schools, laboratories, and libraries.

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NEWS About Your Industry

Southwest Grease and Oil Co. Expands

The Southwest Grease and Oil Company of Wichita, reorganized and incorporated in 1947, has recently completed an $80,000 expansion program. This addition of physical facilities has more than doubled the plant's processing volume.

Additional processing kettles have been installed, as has a new two-story building addition and large elevator to handle raw materials and outgoing shipments of finished products. New trucks have also been added to the fleet of those carrying Wichita-processed lubricants over a wide area in the South and Central West.

The Southwest Grease and Oil Company now makes the solid greases for the large Midwest refinery from which it originally purchased the grease-making equipment. The new additional equipment also permits Southwest to greatly increase its volume for other private label accounts.

Harold Mayor, Sr., is president of Southwest Grease and Oil. His son, Harold, Jr., who has worked up in the firm, is executive vice president. Other major officers who were with Mayor in the early stages of the business are: H. J. Steffens, secretary; Ted Prichard, vice president in charge of manufacturing; M. L. Carter, treasurer and head chemist.

New Chaffee Sales Representative

Chaffee Design and Manufacturing Company, East Aurora, New York, designers and builders of special production and packaging machinery, announce the appointment of Hardy, Hember & Company of Chicago, Illinois as their representative in the Chicago area.

This sales organization specializes in the plant equipment field with both principals graduate engineers who have had years of actual production engineering experience as well as sales experience.

The "know-how" background of both Mr. C. G. Hember and Mr. F. A. Hardy are as valuable to plant management in the Chicago area as the products they sell.

New Construction For Continental Oil

Continental Oil Company has awarded a contract for construction of a $2,250,000 research laboratory building in Ponca City, Okla., that will provide the company with one of the most advanced development and research programs in the American oil industry, it has been announced by President L. F. McCollum. The new structure, as shown in the architect's sketch, above, will be three stories and is expected to be completed in the fall of 1951. Approximately half of the building will be occupied by the company's central research laboratories, which will include an organic chemical laboratory, comprised of a petroleum chemical division and a lubricating oil division; a physics research laboratory, for research in electronics, X-ray defraction and mass spectrometry; an analytical laboratory, consisting of both chemical and physical methods units; and a colloid laboratory, for carrying on fundamental work on greases and allied materials.

Emery Publishes Fatty Acid Bulletin

Emery Industries, Inc., Cincinnati, announces publication of a new bulletin, "Emery's Solid Fatty Acids," available on request.

Complete information on specifications, characteristics such as stability, composition, high quality, uniformity, and their effect on finished products utilizing fatty acids is included in the bulletin.

Other factors such as processing methods and packaging are also covered by the comprehensive report.

Deep Rock Oil Corp. Dedicates New Units

Deep Rock Oil Corporation dedicated its new catalytic cracking gasoline plant and other new units at its Cushing, Oklahoma, refinery in a two-day celebration September 11 and 12.

Deep Rock families and community guests were invited to attend the preview open house Monday afternoon, September 11. Visitors in small groups were taken on tours of the plant with technical refinery personnel acting as guides to explain the operations.

Dedication ceremonies at high noon Tuesday were highlighted with an address by world-famous petroleum scientist, Dr. Gustav Egloff, director of research for Universal Oil Products Company, the firm which designed the new cracking unit.

The dedication climaxed a modernization program begun by Deep Rock at the refinery in 1949 to increase the plant's capacity nearly 50 per cent and to take advantage of the most modern equipment available for producing petroleum products.

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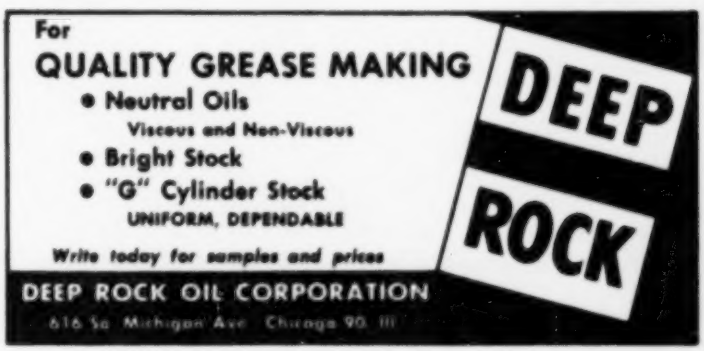

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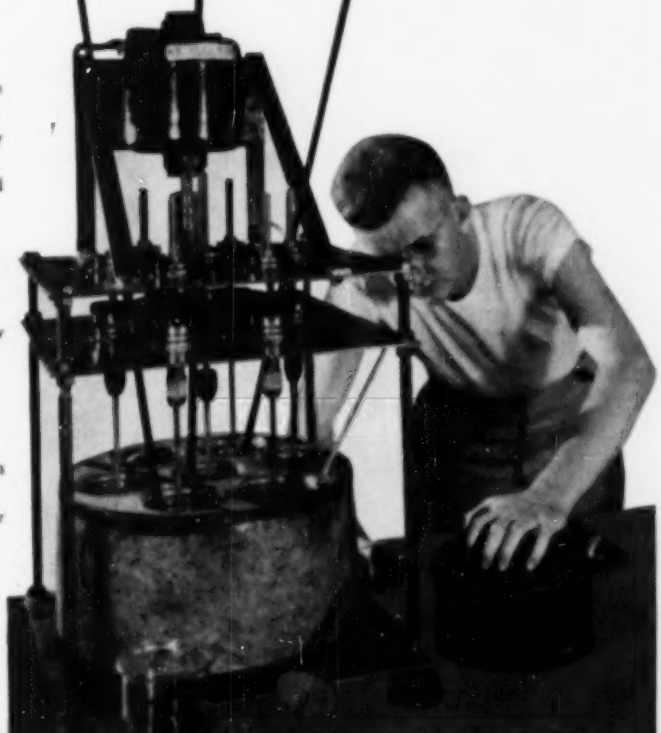

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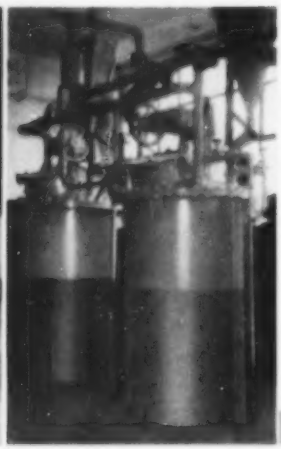

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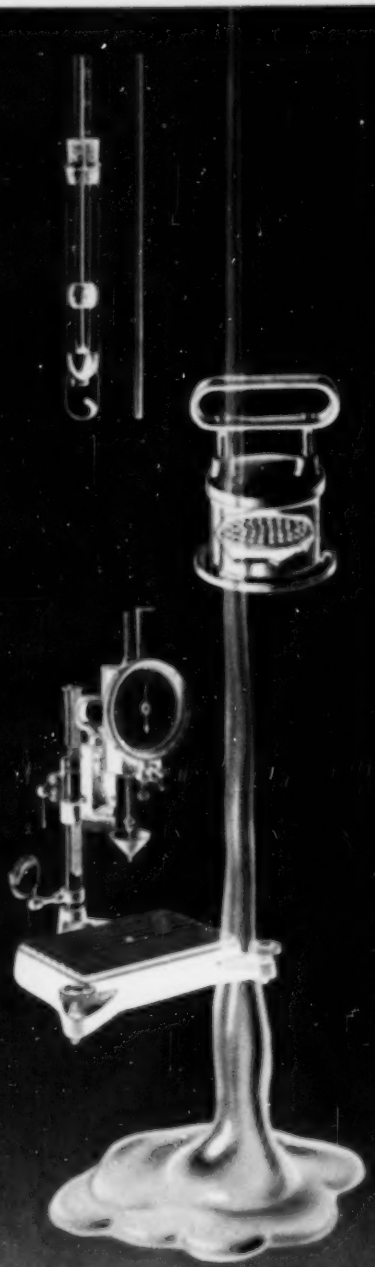

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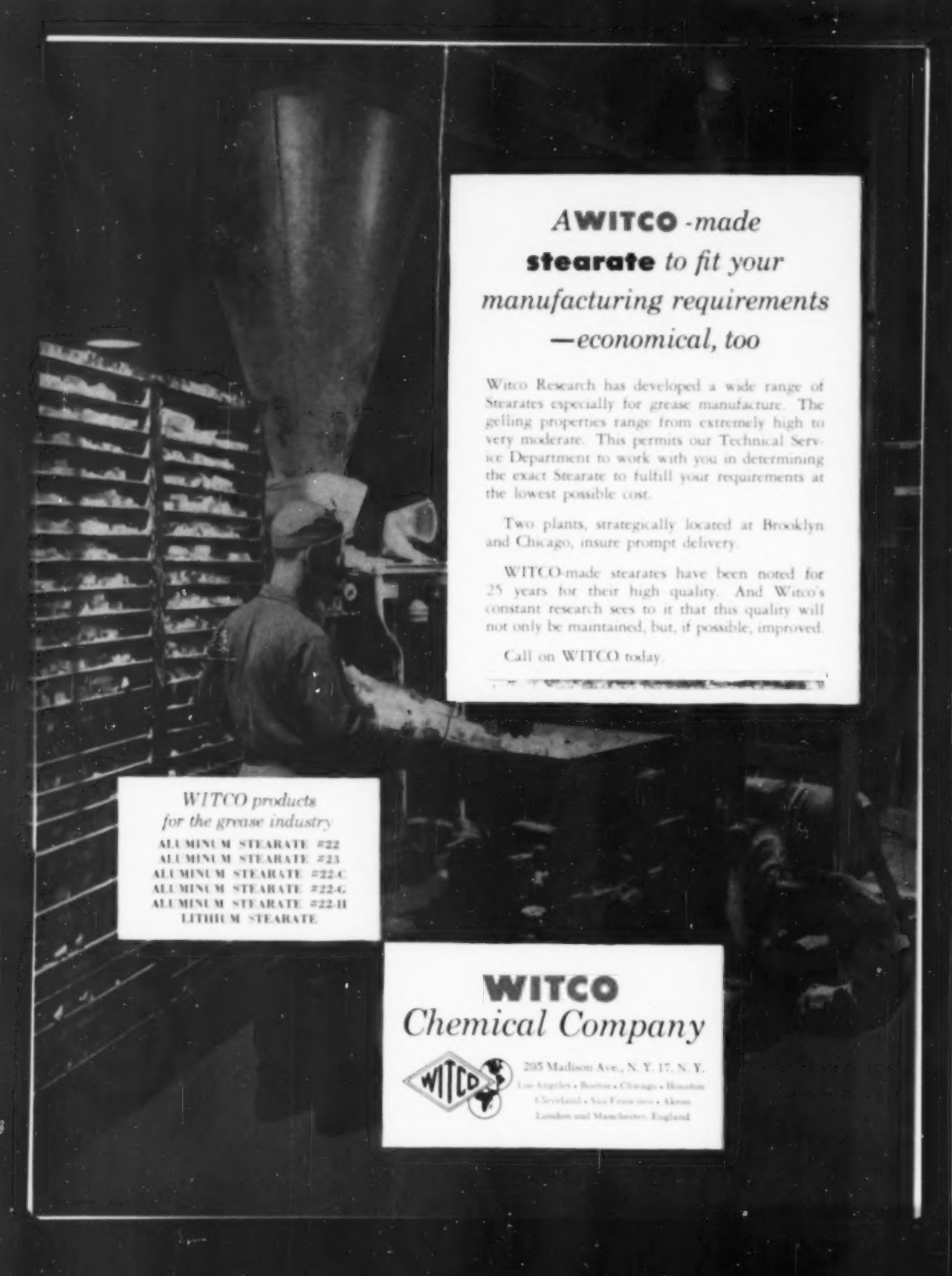

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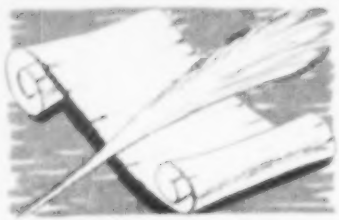

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Kansas City 2, Missouri

You Specify the melting point with a HYDROFOL GLYCERIDE!

Need a hydrogenated fat that melts at 66° Centigrade?—or 41°?—or at any other exact temperature between the ranges of 30° and 88° Centigrade?

You can specify the melting point when you order HYDROFOL GLYCERIDES, because HYDROFOLS are hydrogenated to the values you need in your production.

There's no reason to blend together two products of different M.P., then find that although you've obtained the melting point you want, this mixture now has other properties you don't want. Melting point control for HYDROFOL GLYCERIDES also means complete control of other properties... Acid Number, Iodine Number, Saponification Number.

And HYDROFOLS are free from moisture and impurities. Glyceride colors range from an off-white to a pure white. Specifications are available for standard products, and we will make to your order, if possible.

Remember, if you're looking for a hydrogenated fat of controlled composition and a specific melting point, then try a sample of one of the HYDROFOL GLYCERIDES. Tell us what you want, and we'll ship it to you immediately.

HYDROFOL GLYCERIDE

Specifications for HYDROFOL GLYCERIDES 150-B
Melting Point . . . . . 67° to 69° C
Titre . . . . . 60° to 68° C
Free Fatty Acid . . . . . 2.0% maximum
Acid Number . . . . . 4.0 maximum
Iodine Number . . . . . 3.0 maximum
Saponification Number . . . . . 190 to 198
Specific Gravity @ 140/25° C 0.898

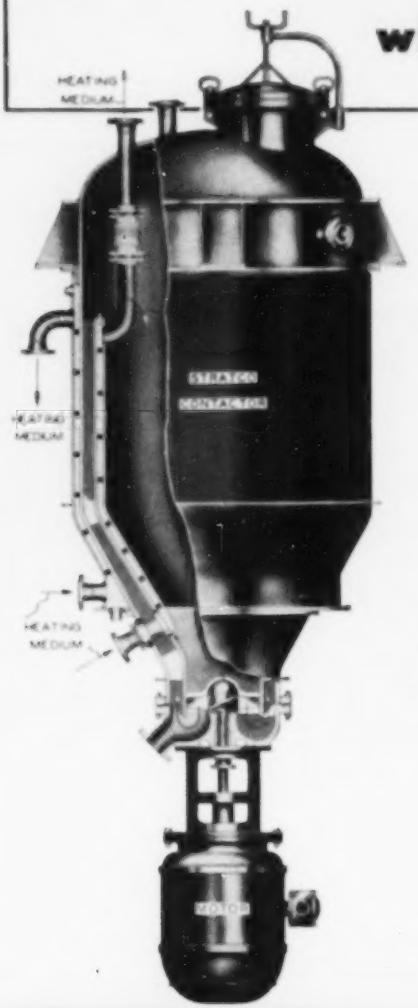
Hydrofol PRODUCTS

ARCHER-DANIELS-MIDLAND COMPANY

(THE WARNER G. SMITH COMPANY DIV.)

Chemical Dept 2191 WEST 110th STREET • CLEVELAND 2, OHIO

GREASE MANUFACTURE SIMPLIFIED
Time Saved . . . Cost Reduced
with the STRATCO



High Dispersion CONTACTOR
and Oil Circulation Heating System

This equipment puts your plant on an eight hour basis, simplifies laboratory control, reduces manpower requirements, produces a more uniform product at lower cost.

The Contactor is also adaptable to any other mixing problem where one or more of the materials to be mixed is a liquid.

STRATFORD ENGINEERING
CORPORATION
PETROLEUM REFINING ENGINEERS

DIERKS BLDG. KANSAS CITY, MO.